

Report on science classes and a workshop for teen students to learn geography and geology using Minecraft

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We sincerely apologize that the abstract and poster are partially different. The second class of Workshop 1, which we mentioned in the abstract, was scheduled to be held on March 17, and we were going to conduct a comparison experiment between classes that use Minecraft and those that don't use Minecraft, but we were unable to do it because of the school being closed due to the spread of COVID-19 infection. You can download the games from the website in the red frames on this poster. We'd love to receive your feedback!

Why did we start this study?

Once upon a time, there was a young teenager who played games everyday...

I have never seen him read a book.
I often hear similar stories from parents who have children of the same generation.

However:
Their way of collecting information seems to be different from the older generation

- Anything by video search. Anything by YouTube.
- Information is shared immediately on SNS.

They can make as much effort as possible to win computer games.

• **Games give even unmotivated children drive**

- Even introverted children communicate and cooperate. (They chat with foreign players using Google Translator)
- They can read text carefully in order to finish games.
- They can collect information thoroughly and overcome various difficulties to finish games!

↓
• **Isn't it possible to use games as teaching materials suitable for the digital natives?**

• **Can games be visually impressive teaching materials?**

We hope children can have a geographical perspective, and an interest in and awareness of topography and geology.



Minecraft (Mojang/Microsoft): A computer game in which a user's avatar can perform mining, building, and crafting in a virtual world that looks like blocks.

Why Minecraft?

- ✓ Persistent popularity among young people (more than 100 million sold)
- ✓ Easy to build buildings and mechanisms of game
- ✓ It's not impossible to import digital elevation models
- ✓ We noticed that several national mapping agencies had released map data to Minecraft (England, France, Sweden, Denmark, etc.)

Workshop 1: Transfer of knowledge

Theme: geology, regional geological history

Students:

First grade students (12-13 years old; more than 150 students) of the Junior High School Miyagi University of Education in Sendai City, Japan

What we want to teach:

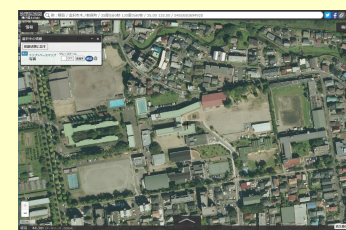
The formation of the earth where the school is standing (the Kamisugi district in Sendai City) as a curriculum of science classes

Goal:

Interest in the local geological history, and an understanding of the moving earth



Photos of the school



Aerial photograph (GSI)



3-D image (Google Earth)

In the Minecraft world, school buildings and facilities familiar to students were built by referring to the photos, aerial photographs, and 3-D images of Google Earth.

To the users of Minecraft Education Edition: Please try the English version of the game used in Workshop 1! Your feedback is welcome! Visit ↓
<https://www.gsi.go.jp/chirijoho/chirijoho-e31006.html>

The Minecraft world used in this workshop (Education Edition)



At the school, a 40m boring survey had been conducted in the schoolyard in the past (Kawamura et al., 2018). The underground strata were designed based on the columnar section.

Aggregation of strata and design of Minecraft blocks

Unit	Lithology	Block
Fill dirt	fill dirt	
Alluvial	silt with organic materials, sand	
Terrace sediments	gravel	
	sandstone to granule conglomerate	
	interbedded sandy siltstone and fine-grained sandstone	
	middle- to coarse-grained sandstone	
	siltstone with many sand pipes	
	middle-grained sandstone with pumice	
	coarse-grained sandstone	
	fine- to middle-grained sandstone	
Tatsunokuchi formation	fine-grained sandstone to siltstone	
	coarse-grained sandstone	
	silty fine- to middle-grained sandstone	
	siltstone with many sand pipes	
	middle- to very coarse-grained sandstone with pumice	
	fine- to middle-grained sandstone	
	silty fine- to very coarse-grained sandstone with sand pipes	
	middle- to very coarse-grained sandstone	
	brown coal	
Kameoka formation	mainly siltstone	
	mainly coarse- to very coarse-grained sandstone	
	mainly siltstone	
	mainly middle- to coarse-grained sandstone	
	bottom of the virtual world	



Era of the terrace sediments (120 Ka – 20 Ka)
Keywords: Ice Age, riverbank, Old Stone Age

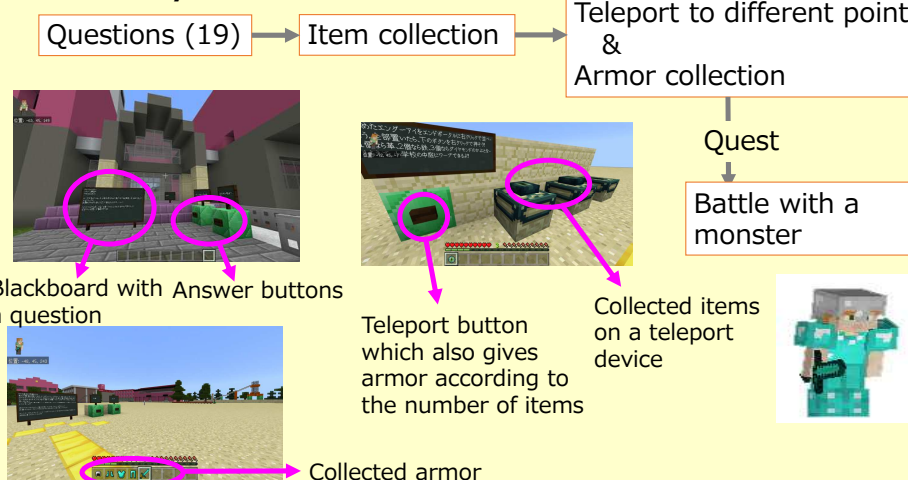


Era of the Tatsunokuchi formation (5.4 Ma – 5 Ma)
Keywords: Marine strata, Fossils of marine animals



Era of the Kameoka formation (6 Ma – 5.4 Ma)
Keywords: Terrestrial strata, Marsh, Brown coal

Game story:



A vertical hole leading underground. This hole was constructed at the location corresponding to the actual boring site.



In the vertical hole, there are stairs and buttons to teleport to the paleoenvironments.



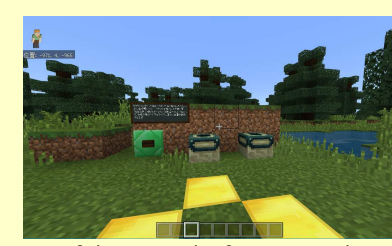
The question to teleport to the Era of the terrace sediments.



Era of the terrace sediments. The view is conscious of the ruins found in Sendai. The questions focused on sedimentation of the river.

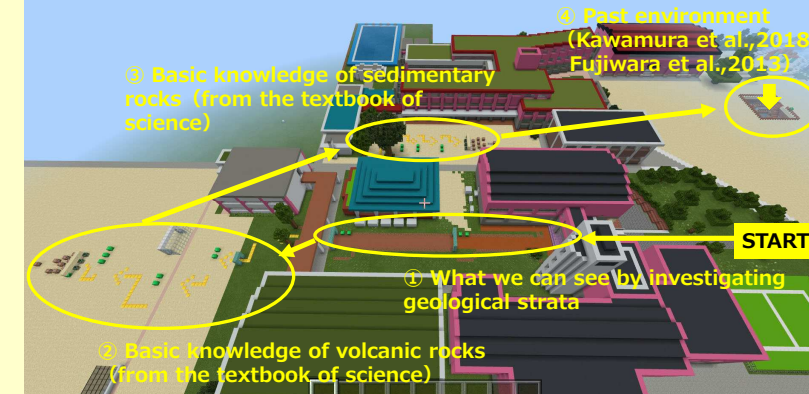


Era of the Tatsunokuchi formation. The questions focus on sea level and climate change.

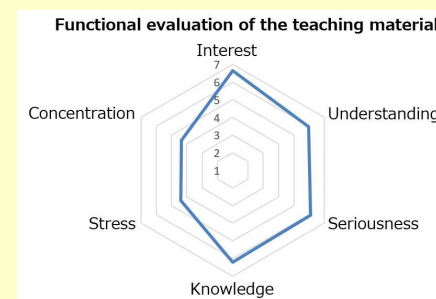
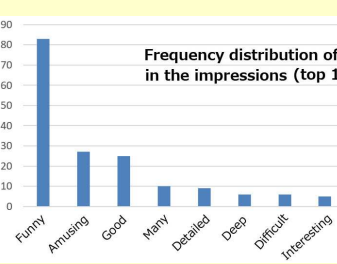
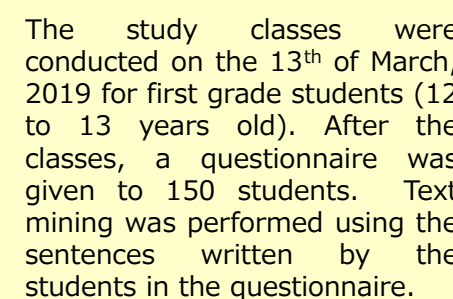


Era of the Kameoka formation. The questions focus on sedimentation of the brown coal.

Placed issues:



Students get items that they can exchange for armor when they select the answers correctly. Some questions on the blackboards require reading hints from long sentences or require consideration. Some questions suggest information about good places to see the actual fossils or strata.



The lecture was done by a teacher, Mr. Yohei Nishikawa of the school



Workshop 2: "Thinking"

Theme: landforms and natural disasters

Students:

Junior high school and high school girls (15-17 years old, 7 students) who were interested in STEM and attended a science camp which encouraged girls in STEM courses

What we want to teach:

- Relationship between landforms and natural disasters, and investigation using thematic maps published on the web.
- Experience to make better choices by themselves, considering various conditions (although there is no correct answer).

Goal:

We hope that in the future, when choosing their place of residence, they will remember that there are relationships between landforms and disasters and there is a way to refer to such information.

Flyer of the Workshop 2

Let's build a house on your favorite land with Minecraft

- Step1** Learn how to use web maps to refer to landforms and their history.
- Step2** Use Minecraft to build a house on your favorite land on virtual terrain.
- Step3** Let's introduce and appreciate everyone's house.

(After this class)

Review the handouts at home, refer to the landforms and terrain around your home, and take a look at hazard maps.

Rules for the instructor:

- Do not criticize student's crafts
- Tell them to remember this lecture when deciding where to live in the future

Snapshots of the workshop

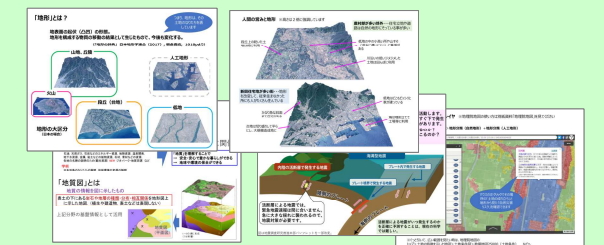
(Photo: Naoko Nagumo of PWRI)



The lecture of landforms and natural disasters



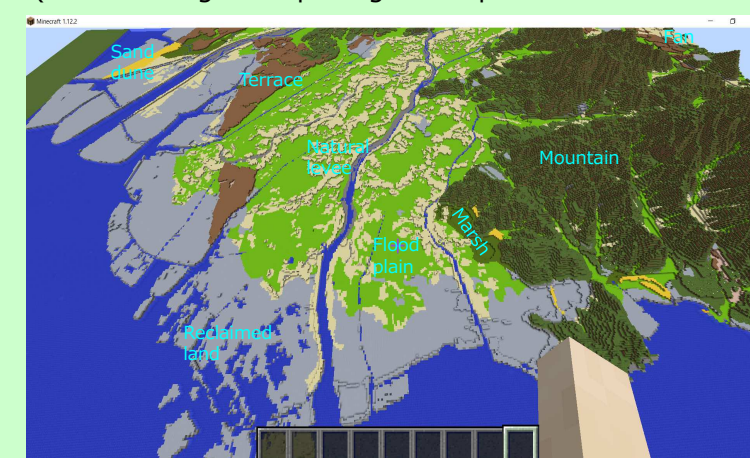
Crafting of Minecraft buildings



Handouts and the web map site used in the lecture (portion)
(the web map: GSI Maps <https://maps.gsi.go.jp>)

The Minecraft world used in this workshop: (Java edition)

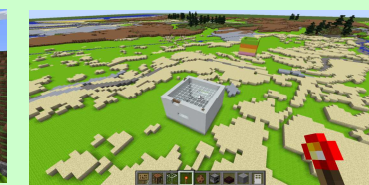
(based on a geomorphological map and 30 m DEM of Nishio City, Aichi Pref.)



The students started their crafting after a short lecture of the landforms of this area, referring elevation stage, geomorphology, active faults referred in GSI Maps (web map).

To the users of Minecraft JAVA Edition: Would you mind to build a building or town on the terrain model used in Workshop 2? Please email or send to the twitter (@GSI_Research) your screenshot and the reason why you built it there! Visit ↓
<https://www.gsi.go.jp/chirijoho/chirijoho-e31006.html>

The crafts of students:



There were some points which need to be improved:

The crafts of the students who love Minecraft tend to have a design and location without regard to the lecture.

- ➔ Warnings and guidances are required in the world?

Resolution of the terrain

- ➔ Balance with PC operation...
- ➔ Low resolution for a bird's eye view, high resolution for crafting?

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